① Use synthetic division to find the upper and lower bounds of the real zeros of $f(x) = 2x^3 - 3x^2 - 12x + 8$.

② Without a calculator, sketch a graph of $f(x) = -\frac{1}{3}(x+1)(x-2)^2$.

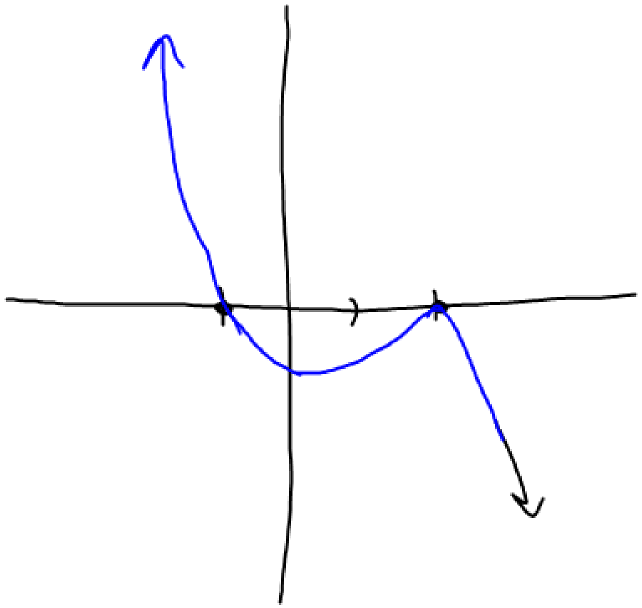
degree 3

L.C. neg

zeros

-1, 2

cross, bounce



$f(x) = 2x^3 - 3x^2 - 12x + 8.$

Rational Zero Test

$$\frac{\pm 1 \ \pm 2 \ \pm 4 \ \pm 8}{\pm 1 \ \pm 2}$$

positive → 4

4	2	-3	-12	8
		8	20	32
	2	5	8	40

all positive → 2 5 8 40

neg. → -4

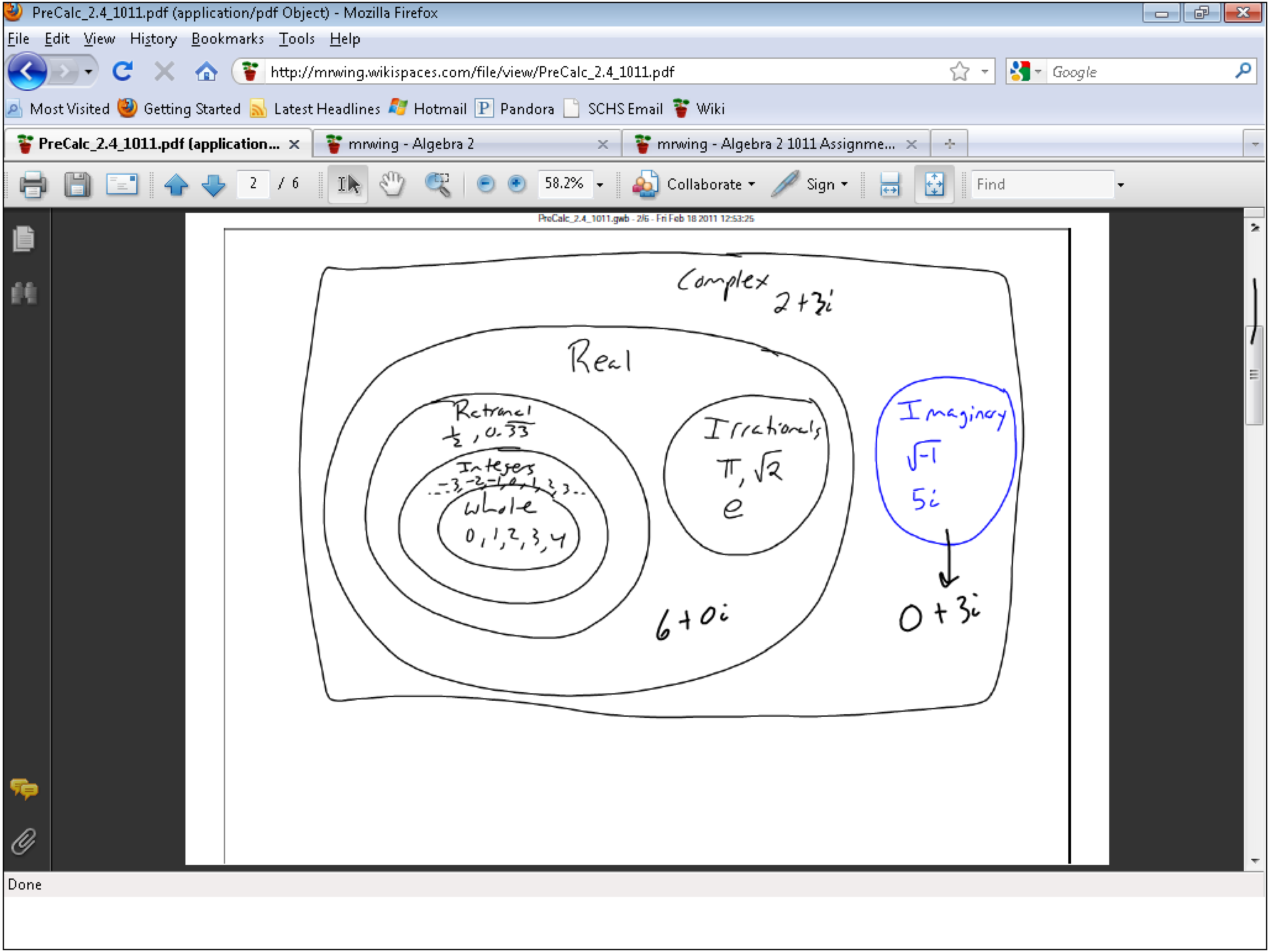
-4	2	-3	-12	8
		-8	44	-128
	2	-11	32	-120

Zero - wild card

alternates pos./neg.

Review

- p.101 Even/odd functions
- p.101 Leading Coefficient
- p.104 Even/odd multiplicity
- p.107 Intermediate value theorem
- p.112 Long ÷ polynomials
- p.115 synthetic ÷ (restrictions)
- p.116 Remainder theorem
- p.118 Rational Zero test
- p.120 Descarte's Rule Signs
- p.121 Upper/lower bounds
- Sect. 2.4 Complex #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Complex 2+3i
Real
Rational
½, 0.33
Integers
...-3,-2,-1,0,1,2,3...
whole
0,1,2,3,4
Irrationals
π, √2
e
6+0i
Imaginary
√-1
5i
0+3i
Done

$i = \sqrt{-1}$

$i^2 = -1$

$x^2 + 1 = 0$

$\quad -1 \quad -1$

$x^2 = -1$

$\sqrt{\ } \quad \sqrt{\ }$

$x = \pm\sqrt{-1}$

$x = \pm i$

$\sqrt{-100} = 10i$

$\sqrt{-25} = 5i$

$\sqrt{-7} = \sqrt{7}\, i$

$\sqrt{-8} = 2\sqrt{2}\, i$

Sq. root asks what times itself equals the number in the $\sqrt{\ }$

$\sqrt{4} \rightarrow 2 \cdot 2$

$\quad -2 \cdot -2$

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$(2+3i)+(4+5i)=6+8i$

$(3-2i)-(6+3i)=-3-5i$

$6-(3+2i)=3-2i$

$(6+0i)-(3+2i)=3-2i$

$(3+2i)(4+3i)$

$12+9i+8i+6i^2$

$12+17i+6i^2$

$12+17i+6(-1)$

$\boxed{6+17i}$

Done

$$\frac{\frac{1}{4}}{\frac{2}{3}} \Rightarrow \frac{1}{4}\cdot\frac{3}{2} = \boxed{\frac{3}{8}}$$

$$\frac{1}{\sqrt{2}}\cdot\frac{\sqrt{2}}{\sqrt{2}} = \boxed{\frac{\sqrt{2}}{2}}$$

write in standard form

$$\frac{2+3i}{4-2i}$$ mult. by conjugate of the bottom

$a+bi$

$$\frac{2+3i}{4-2i}\cdot\frac{4+2i}{4+2i} = \frac{8+16i+6i^2}{16-4i^2} = \frac{8+16i-6}{16+4} = \frac{2+16i}{20} = \boxed{\frac{1}{10}+\frac{4}{5}i}$$

Fundamental Theorem of Algebra

→ a polynomial with degree n has exactly n zeros, and n linear factors.

$x^5 \rightarrow (\quad)(\quad)(\quad)(\quad)(\quad)$

2.5a

Find the zeros and factors of each polynomial and show your understanding of synthetic division and rational zero test and upper/lower bounds.

① $f(x) = x^4 - 5x^3 + 15x^2 - 45x + 54$

② $f(x) = x^4 + 2x^3 + 10x^2 + 18x + 9$

③ $f(x) = x^5 + x^3 + 2x^2 - 12x + 8$

④ $f(x) = x^3 + 4x$

⑤ $f(x) = x^4 - 3x^3 + 6x^2 + 2x - 60$